

# Investigation 2

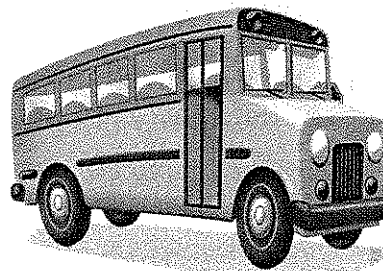
## Using Graphs to Explore Data

Sometimes data may be spread out. When these data are displayed on a line plot or a bar graph, it is not easy to see patterns. In this investigation, you will learn how to highlight data using displays called stem-and-leaf plots and back-to-back stem-and-leaf plots to help you see patterns.

In Investigation 1, you analyzed single sets of data. Sometimes you may want to analyze whether there is a relationship between two different data sets. In this investigation, you will learn how to display data pairs from two different data sets using a coordinate graph.

### 2.1 Traveling to School

While investigating the times they got up in the morning, a middle-school class was surprised to find that two students got up almost an hour earlier than their classmates. These students said they got up early because it took them a long time to get to school. The class then wondered how much time it took each student to travel to school. The data they collected are on the next page.



#### Getting Ready for Problem 2.1

Use the table on the next page to answer these questions:

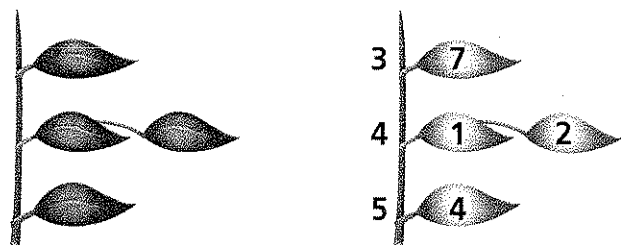
- What three questions did the students ask?
- How might the students have collected the travel-time data?
- Would a line plot be a good way to show the data? Why or why not?

### Times and Distances to School

Student's Initials	Time (minutes)	Distance (miles)	Mode of Travel
DB	60	4.50	Bus
DD	15	2.00	Bus
CC	30	2.00	Bus
FH	35	2.50	Bus
SE	15	0.75	Car
AE	15	1.00	Bus
CL	15	1.00	Bus
LM	22	2.00	Bus
QN	25	1.50	Bus
MP	20	1.50	Bus
AP	25	1.25	Bus
AP	19	2.25	Bus
HCP	15	1.50	Bus
KR	8	0.25	Walking
NS	8	1.25	Car
LS	5	0.50	Bus
AT	20	2.75	Bus
JW	15	1.50	Bus
DW	17	2.50	Bus
SW	15	2.00	Car
NW	10	0.50	Walking
JW	20	0.50	Walking
CW	15	2.25	Bus
BA	30	3.00	Bus
JB	20	2.50	Bus
AB	50	4.00	Bus
BB	30	4.75	Bus
MB	20	2.00	Bus
RC	10	1.25	Bus
CD	5	0.25	Walking
ME	5	0.50	Bus
CF	20	1.75	Bus
KG	15	1.75	Bus
TH	11	1.50	Bus
EL	6	1.00	Car
KLD	35	0.75	Bus
MN	17	4.50	Bus
JO	10	3.00	Car
RP	21	1.50	Bus
ER	10	1.00	Bus

The students decide to make a stem-and-leaf plot of the travel times.

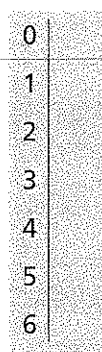
A **stem-and-leaf plot** looks like a vertical stem with leaves to the right of it. It is sometimes simply called a *stem plot*.



To make a stem plot to represent travel times, separate each data value into a left “stem” and a right “leaf.”

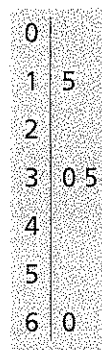
For these data, the “stem” will be the tens digits. Because the travel times include values from 5 minutes to 60 minutes, the stem will be the digits 0, 1, 2, 3, 4, 5, and 6.

- Make a vertical list of the tens digits in order from least to greatest.
- Draw a line to the right of the digits to separate the stem from the “leaves.”



The “leaves” will be the ones digits. For each data value, add a leaf next to the appropriate tens digit on the stem.

- The first data value is 60 minutes. Write a 0 next to the stem of 6.
- The next value is 15 minutes. Write a 5 next to the stem of 1.
- The travel times of 30 and 35 minutes are shown by a 0 and 5 next to the stem of 3.



### Problem 2.1 Making a Stem-and-Leaf Plot

- A. Use the Travel to School data to make the stem plot. The plot is started for you.

0	
1	5 5 5 5
2	2 5 0
3	0 5
4	
5	
6	0

- B. Now redraw the stem plot, putting the data in each leaf in order from least to greatest. Include a title for your plot. Also include a key like the following that tells how to read the plot.

Key  
2 | 5 means 25 minutes

- C. Which students probably get to sleep the latest in the morning? Why do you think this?
- D. Which students probably get up the earliest? Why do you think this?
- E. What is the median of the travel-time data? Explain how you found this.
- F. What is the range of the travel-time data? Explain.

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## 2.2 Jumping Rope

Mrs. Reid's class competed against Mr. Costo's class in a jump-rope contest. Each student jumped as many times as possible. Another student counted the jumps and recorded the total. The classes made the *back-to-back stem plot* shown to display their data. Look at this plot carefully. Try to figure out how to read it.

When the two classes compare their results, they disagree about which class did better.

- Mr. Costo's class says that the range of their data is much greater.
- Mrs. Reid's class says this is only because they had one person who jumped many more times than anybody else.
- Mrs. Reid's class claims that most of them jumped more times than most of the students in Mr. Costo's class.
- Mr. Costo's class argues that even if they do not count the person with 300 jumps, they still did better.

Number of Jumps

Mrs. Reid's class		Mr. Costo's class
8 7 7 7 5 1 1	0	1 1 2 3 4 5 8 8
6 1 1	1	0 7
9 7 6 3 0 0	2	3 7 8
7 6 5 3	3	0 3 5
5 0	4	2 7 8
	5	0 2 3
2	6	0 8
	7	
9 8 0	8	
6 3 1	9	
	10	2 4
3	11	
	12	
	13	
	14	
	15	1
	16	0 0
	17	
	18	
	19	
	20	
	21	
	22	
	23	
	24	
	25	
	26	
	27	
	28	
	29	
	30	0

Key: 7 | 3 | 0 means 37 jumps for Mrs. Reid's class and 30 jumps for Mr. Costo's class

## Problem 2.2 Comparing Distributions

- A. Which class did better overall in the jump-rope contest? Use what you know about statistics to help you justify your answer.
- B. In Mr. Costo's class, there are some very large numbers of jumps. For example, one student jumped 151 times, and another student jumped 300 times. We call these data outliers. **Outliers** are data values that are located far from the rest of the other values in a set of data. Find two other outliers in the data for Mr. Costo's class.
- C. An outlier may be a value that was recorded incorrectly, or it may be a signal that something special is happening. All the values recorded for Mr. Costo's class are correct. What might account for the few students who jumped many more times than their classmates?

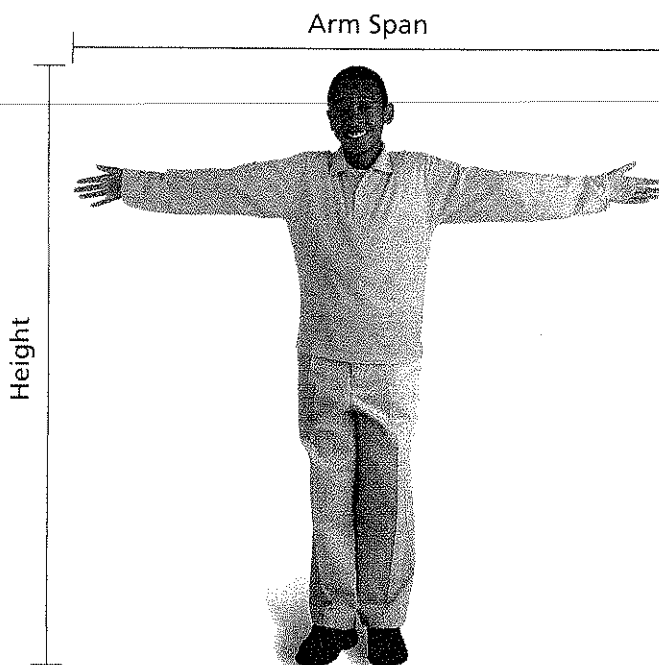
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## 2.3 Relating Height to Arm Span

In earlier problems, you worked with one measure at a time. For example, you looked at the number of letters in students' names and travel times to school. In this problem, you will look at the relationship between two different counts or measures.

If you look around at your classmates, you might guess that taller people have wider arm spans. But is there *really* any relationship between a person's height and his or her arm span? The best way to find out more about this question is to collect some data.

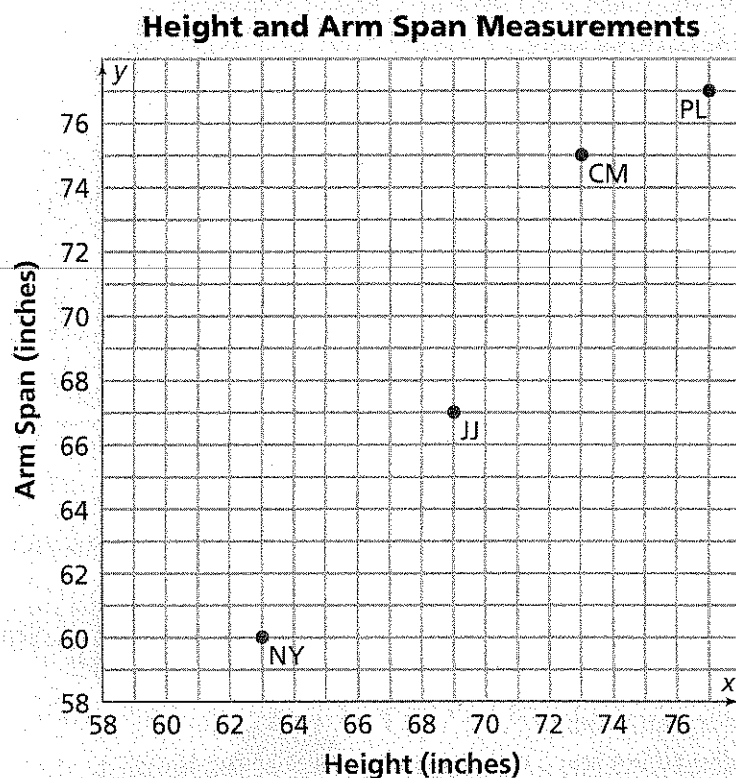


Here are data on height and arm span (measured from fingertip to fingertip) that one class collected.

**Height and Arm Span Measurements**

Initials	Height (inches)	Arm Span (inches)
NY	63	60
JJ	69	67
CM	73	75
PL	77	77
BP	64	65
AS	67	64
KR	58	58

You can show two different data values at the same time on a **coordinate graph**. Each point on a coordinate graph represents two data values. The horizontal axis, or **x-axis**, represents one data value. The vertical axis, or **y-axis**, represents a second data value. The graph below shows data for height along the x-axis and data for arm span along the y-axis. Each point on the graph represents the height and the arm span for one student.



Study the table of data on the previous page and the coordinate graph. Four points have already been plotted and labeled with the students' initials. The location of each point is shown in the table at the right.

Initials	Point
NY	(63, 60)
JJ	(69, 67)
CM	(73, 75)
PL	(77, 77)

### Getting Ready for Problem 23

- Where would you place the points and initials for the remaining three people?
- Why do the axes of the graph start at (58, 58)?
- What would the graph look like if the axes started at (0, 0)?



## Problem 2.3 Making and Reading Coordinate Graphs

Collect the height and arm span data of each person in your class. Make a coordinate graph of your data. Use the graph to answer the questions.

- A. If you know the measure of a person's arm span, do you know his or her height? Explain.
- B. Draw a diagonal line on the graph that would represent points at which arm span and height are equal.
  1. How many data points lie on this line? How does arm span relate to height for the points *on* the line?
  2. How many data points lie below this line? How does arm span relate to height for the points *below* the line?
  3. How many data points lie above this line? How does arm span relate to height for the points *above* the line?

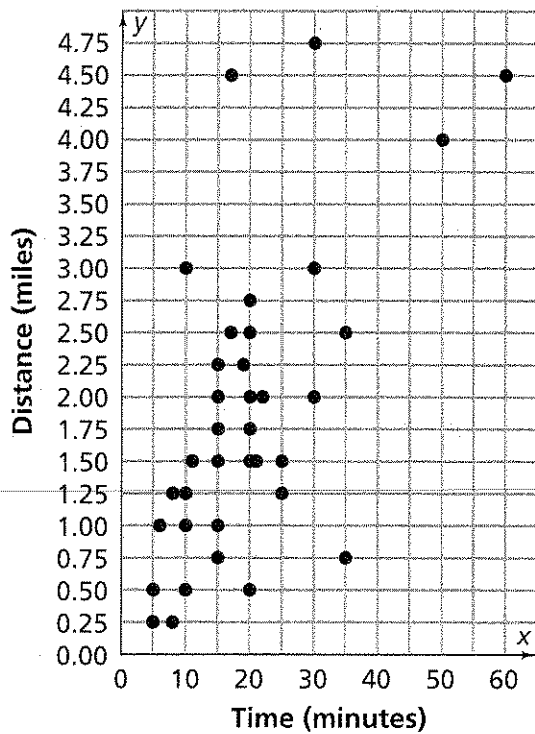
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## 2.4 Relating Travel Time to Distance

In Problem 2.1, you made stem-and-leaf plots to show data about travel times to school. You can use the same data to look at the relationship between travel time and distance from home to school on a coordinate graph.



**Times and Distances to School**



### Problem 2.4 Using Coordinate Graphs to Find Relationships

Study the graph above and the data from Problem 2.1.

- A. Copy the coordinate graph. Mark and label a point with the student's initial for the first five students in the table.
- B. If you know a student's travel time, what do you know about that student's distance from school? Use the graph to justify your answer.
- C. Locate each set of points on the coordinate graph. What can you tell about travel time and distance from school for the students these points represent?
  1. (17, 4.50) and (60, 4.50)
  2. (30, 2.00), (30, 3.00), and (30, 4.75)
  3. (17, 4.50) and (30, 4.75)
- D.
  1. Why do the axes have different scales?
  2. What would the graph look like if both axes used the same scales?

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